

TITLE OF THE INVENTION

Apparatus and method to use a conventional telephone set to make telephone calls on a packet network.

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FIELD OF THE INVENTION

The present invention relates to packet networks. More specifically, the present invention is concerned with a method and an apparatus to use a conventional telephone set to make telephone calls on a packet network.

BACKGROUND OF THE INVENTION

The prior art is replete with software enabling a first user to establish a telephone-like conversation with a second user running the same software via a packet network, such as, for example, the Internet.

These softwares usually run on personal computers equipped with microphones to capture the sounds and with sound cards to reproduce the sounds from the other user. The software therefore captures the sound from a first user, digitises it, compresses it, and forwards it to the Packet Network address (Internet Protocol address or IP address) of the second user. The sounds is then uncompressed, transferred back to analog sound by the sound card and reproduced on the premises of the second user. Of course, these steps are performed bidirectionally to result in a full duplex connection.

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The drawbacks of the above mentioned software system are multiple. For example, a dedicated PC must be used as a telephone, both users must be similarly equipped and running the same software and it is not possible to reach users equipped with conventional telephones.

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OBJECTS OF THE INVENTION

An object of the invention is to provide an apparatus and
10 a method to use a conventional telephone set to make telephone calls on a packet network.

SUMMARY OF THE INVENTION

15 More specifically, in accordance with the present invention, there is provided a telephone to packet adapter comprising:
a telephone line interface configured to be connected to a telephone line;
a telephone interface configured to be connected to a
20 telephone set;
a Local Area Network interface configured to be connected to a packet network;
a controller circuit interconnecting the telephone line interface, the telephone interface and the Local Area Network interface;
25 the controller circuit being so configured as to route the telephone interface to one of the telephone line and the Local Area Network interfaces depending on at least one preestablished routing rule.

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According to another aspect of the present invention, there is provided a telephone to packet adapter comprising:

a telephone line interface configured to be connected to a telephone line;

5 a telephone interface configured to be connected to a telephone set;

a Local Area Network interface configured to be connected to a Local Area Network;

10 a packet network interface configured to be connected to a packet network; and

a controller circuit interconnecting the telephone line interface, the telephone interface, the Local Area Network interface and the packet network interface; the controller circuit being so configured as to either a) route the telephone interface to one of the telephone line and the packet network interfaces and b) route the Local Area Network interface to one of the telephone line and the packet network interfaces depending on at least one preestablished routing rule.

20 According to another aspect of the present invention, there is provided a method for routing telephone calls to a packet network via a telephone to packet adapter provided with a telephone line interface, a telephone interface, a Local Area Network interface and a controller circuit interconnecting the telephone line, telephone and Local Area Network interfaces; the method comprising the steps of:

25 connecting a telephone line to the telephone line interface;

connecting a telephone set to the telephone interface;
connecting a packet network to the Local Area Network interface;

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running an agent software for routing the telephone interface to either the conventional telephone line interface and the Local Area Network interface depending on at least one preestablished routing rule.

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According to yet another aspect of the present invention, there is provided a method for routing telephone calls to a packet network via a telephone to packet adapter provided with a telephone line interface, a telephone interface, a Local Area Network interface, a packet network interface and a controller circuit interconnecting the telephone line, telephone, packet network and Local Area Network interfaces; the method comprising the steps of:

- 10 connecting a telephone line to the telephone line interface;
- 15 connecting a telephone set to the telephone interface;
 connecting a Local Area Network to the Local Area Network interface;
- 20 connecting a packet network interface to the packet network interface;
- 25 running an agent software for routing either a) the telephone interface to one of the conventional telephone line interface and the packet network interface, and b) the Local Area Network interface to one of the conventional telephone line interface and the packet network interface, depending on at least one preestablished routing rule.

It is to be noted that the term "telephone call" is to be construed as meaning any calls conventionally made via telephone lines such as, for example, voice calls, fax calls and modem calls. Accordingly,

the term "telephone set" is to be construed as meaning any device that produces signals capable of being understood by PSTN equipment expected signals from a conventional telephone set (also known as a POTS (Plain Old Telephone System) telephone set). Therefore, the term
5 "telephone set" includes any POTS devices such as, for example, fax machines, modems and even more advanced devices such as H.324 video phones.

10 Other objects, advantages and features of the present invention will become more apparent upon reading of the following non restrictive description of preferred embodiments thereof, given by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

15 In the appended drawings:

20 Figure 1 is a schematised block diagram illustrating the various components of a telephone to packet adapter according to a first embodiment of the present invention.

Figure 2 is a schematised block diagram illustrating a packet network where users are provided with telephone to packet adapters according to an embodiment of the present invention;

25 Figure 3 is a flow diagram illustrating the general steps taken to establish a communication between user 2 and one of users 1 or 3 of Figure 2;

Figure 4 is a flow diagram illustrating the general steps taken to establish a communication between user 1 and user 2 of Figure 2;

5 Figure 5 is a flow diagram illustrating the general steps taken to establish a communication between one of users 1 or 2 and user 3 of Figure 2; and

10 Figure 6 is a schematised block diagram illustrating the various components of a telephone to packet adapter according to a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Figure 1 of the appended drawings illustrates a block diagram of a full duplex telephone to packet adapter 10 according to a first embodiment of the present invention.

20 The adapter 10 includes a telephone input/output (IO) port 12 to which a conventional telephone (not shown) may be connected, a Local Area Network (LAN) IO port 13 through which connectivity to a LAN or to a Personal Computer (PC) (not shown) is obtained, a telephone line IO port 14 to which a telephone line (not shown), part of the Public
25 Switched Telephone Network (PSTN), may be connected and a packet network interface IO port 16 to which a packet network (not shown) may optionally be connected.

- The adapter 10 electronic circuitry generally includes an analog to digital (A/D) and a digital to analog (D/A) full duplex interface 18 interconnecting a controller circuit 20 and the IO port 12, a Local Area Network interface 23 interconnecting the controller circuit 20 and the IO port 13, a speech encoder/decoder 22 connected to the controller circuit 20, a telephone line interface 24 interconnecting the controller circuit 20 and the IO port 14 and a packet network interface 26 interconnecting the controller circuit 20 and IO port 16.
- 5 The controller circuit 20 is provided with a central processing unit (CPU) and sufficient memory to store a software agent program and other data stored in databases as will be further described hereinafter.
- 10 The speech encoder/decoder 22 includes the required circuitry to perform digital speech and/or data encoding and decoding to decrease the bandwidth required to transfer the information from one user to another and to recuperate the complete information after the transfer.
- 15 It is believed within the reach of one skilled in the art to provide adequate electronic circuitry for the elements 18-26 described hereinabove.
- 20 Turning now briefly to Figure 6 of the appended drawings, a telephone to packet adapter 400 according to a second embodiment of the present invention will be described.
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The telephone to packet adapter 400 is very similar to the telephone to packet adapter 10 described hereinabove. Thus, for

concision purposes, only the differences between these adapters will be described herein.

As can be seen from Figure 6, the telephone to packet adapter 400 is designed to be connected to a packet network 30 via a Local Area Network 31. Thereby, the telephone to packet adapter 400 does not require a packet network interface 26 (Figure 1). It is to be noted that the Local Area Network 31 therefore includes a packet network LAN gateway as is very well known in the art.

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Figure 2 of the appended drawings illustrates a packet network 30, for example, the Internet, to which the users are connected via telephone to packet adapters 10 or 400. It is to be noted that Figure 2 will be further described hereinafter with a view to illustrate some of the various possibilities of the telephone to packet adapters 10 and 400.

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A first user 32 is connected to the packet network 30 via a first service provider 34 and a telephone line 36. The first service provider 34 has a conventional Network Access Server 38 provided with conventional modems (not shown) to interconnect its clients, for example first user 32, to the packet network 30. The first user 32 has a telephone to packet adapter 10a, a conventional modem 40 connected to the packet network IO port 16a, and a telephone set 42 connected to the telephone IO port 12a. It is to be noted that both the Local Area Network port 14 (not shown) and the Local Area Network port 13a of the adapter 10a are not used.

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It is to be noted that the telephone set 42 could be replaced by a Local Area Network (not shown) connected to the Local

Area Network port 13a to therefore enable telephone calls, for example, modem calls, from the Local Area Network to be routed to the packet network 30.

5 Figure 2 also illustrates a second service provider 44 connected to the packet network 30 via an Internet server 46 and including a telephone to packet adapter 400b interconnecting the Internet server 46 and a telephone line 48, the purpose of which will be described hereinafter with reference to Figure 5. More specifically, the server 46 is
10 connected to the Local Area Network IO port 13b of the telephone to packet adapter 400b and the telephone line 48 is connected to the IO port 14b of the telephone to packet adapter 400b. It is to be noted that the IO port 12b is not used.

15 Of course, the telephone to packet adapter 400b of
Figure 2 could advantageously be provided with more than one telephone
line IO ports 14b allowing the telephone to packet adapter 10b to be
connected to more than one telephone line. Indeed, this would allow the
second service provider 44 to interconnect more than two users
20 simultaneously.

It is also to be noted that the telephone to packet adapter 400b of Figure 2 could be replaced by a telephone to packet adapter 10 as illustrated in Figure 1. If this is the case, the packet network IO port 16 will not be used.

The packet network 30 is also connected to a server 50 of a cable company 52 providing Internet services to its clients, for example second user 54, via a conventional television cable 58.

connected to the server 50 via adequate circuitry (not shown) known in the art.

The second user 54 is equipped with a cable modem 60 connected to the conventional television cable 58 and a telephone to packet adapter 400c interconnecting the cable modem 60 and a telephone set 62. The telephone to packet adapter 400c is also connected to a telephone line 64. More specifically, the cable modem 60 is connected to the Local Area Network IO port 13c, the telephone 62 is connected to the IO port 12c and the telephone line 64 is connected to the IO port 14c. The telephone to packet adapter 400c therefore considers the cable modem 60 as a Local Area Network interconnecting the telephone to packet adapter 400 to the packet network 30.

Finally, Figure 2 also illustrates a third user 66 equipped with a telephone set 68 connected to a conventional telephone line 70.

Turning now to Figures 3-5, three different methods of use of the telephone to packet adapters 10 and 400 will be described.

Figure 3 generally illustrates the steps taken when the second user 54 wants to reach another person.

After the telephone to packet adapter 400c is started (step 100) and initialised (step 102), the system waits until the second user 54 picks up the handset of the telephone set 62 and dials a telephone number (step 104).

The agent software of the telephone to packet adapter 400c then verifies if the dialled telephone number is present in a database contained in the controller circuit 20 (Figure 6) (Step 106). This database contains a list of the telephone numbers that may be accessed
5 via the packet network 30.

If the dialled telephone number may not be accessed via
the packet network 30, the agent software of the telephone to packet
10 adapter 400c routes the telephone set 62 to the telephone line 64 and
dials the telephone number (step 108). The telephone number must
therefore be conventionally dialled over a telephone line to establish the
connection. This will be the case, for example, when the number dialled
is local or when there is no service provider similar to the second service
provider 44 in the area of the number dialled.

15 If the dialled number is present in the database, the
agent software then determines if the IP address corresponding to this
telephone number is in its database (step 110). If it is not the case, the
agent software interrogates the Internet server 50 of the cable company
20 52 (or any other server having a correspondence table between IP
addresses and telephone numbers) to find the required IP address (step
112). When this is done, the agent software establishes the connection
between the second user 54 and the other user (for example the first user
32) (step 114).

25 The two connected users may then communicate
normally in full duplex since the conversation is bidirectionally digitised,
transformed into packets and transferred via the packet network 30 to the
other user where it is converted back into an analog signal and supplied

to the handset. Indeed, if the second user 54 is in communication with the first user 32, the telephone to packet adapter 10a will convert back the packets to an analog signal. Similarly, if the second user 54 calls the third user 66, the telephone to packet adapter 400b will do the required
5 conversion.

The telephone to packet adapter 400c then waits until the communication is broken (step 116) and then returns to step 104.

10 An advantage of the above mentioned set of preestablished rules is that the second user 54 may either be transparently in communication with conventional telephone users and users of the present invention. Another advantage, is the possibility to route all the calls to the telephone line 64 should the connection to the
15 packet network 30 via the cable company 52 be inactive, therefore providing a PSTN fallback.

It is to be noted that instead of using the telephone set 62, the second user could connect a LAN (not shown) to the IO port 13c and connect the cable modem 60 to the LAN to therefore call another
20 user similarly equipped through the steps described hereinabove.

Figure 4 of the appended drawings generally illustrates the steps taken when the first user 32 wants to reach another user.
25 Each step 200, 202, 204, 206, 208, 210, 214 and 216 is respectively identical to corresponding step 100, 102, 104, 106, 108, 110, 114 and 116 of Figure 3. Thus, for concision purposes, the description of these steps will not be repeated hereinbelow.

Since the first user is not connected to the Internet via a cable company, the Internet server 38 of the first Internet service provider 34 (or any other server having a table of the IP addresses vs telephone numbers) is interrogated in step 212.

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A step 218 has been added between step 206 and 210 to instruct the modem 40 to connect to the service provider 34.

10 Therefore, according to the above-described set of rules, the telephone line interface 24 is routed to the PSTN if the dialled number is not in the database and routed to the packet network if the dialled number is in the database

15 Again, it is to be noted that instead of using the telephone set 42, the first user could connect a PC (not shown) or a LAN (not shown) to the IO port 13 and call another user similarly equipped through the steps described hereinabove.

20 Finally, Figure 5 of the appended drawings illustrates another use of the telephone to packet adapter 10 of Figure 1. This application is advantageous to reduce the long distance costs of the user.

25 The general principle is to detect if the telephone number dialled by the user is a long distance number and to do a routing of the call to a service provider (for example the second service provider 44 in Figure 1) in the area of the telephone number to therefore prevent any long distance charges to the user if it is so. Of course the service provider 44 is equipped with a telephone to packet adapter 400b that may dial a local number via a telephone line 48.

Again, each step 300, 302, 304, 308 and 316 is identical to the corresponding step 100, 102, 104, 108 and 116 of Figure 1 and described hereinabove. Thus, for concision purposes, the description of these steps will not be repeated hereinbelow.

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In step 306, the telephone to packet adapter determines if the telephone number dialled is a long distance number. If this is not the case, step 308 is done as mentioned above.

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If the telephone number dialled is a long distance number (for example the telephone number of the third user 66), the software agent of the telephone to packet adapter searches a database (located in the controller circuit 20 or in an Internet server) to find the IP address of a service provider equipped with a telephone to packet adapter (for example the second service provider 44) in the area of the telephone number dialled (step 320).

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The telephone to packet adapter then connects with this service provider 44 gives its own IP address and the telephone number of the third user 66 (step 322).

20

The telephone to packet adapter 400b of the second service provider 44 then takes the telephone line 48 and dials the received telephone number to establish the communication with the third user (step 324).

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Again, the use of the telephone to packet adapter 400 is transparent to the user since only one number is dialled. Also, the above-described set or preestablished rules enables the user of the

present invention to communicate with a user of a conventional telephone.

It is to be noted that it would also be possible to make
5 a local call to a user of a conventional telephone by using a local service provider equipped with a telephone to packet adapter to do local calls. This way, the second user 54, for example, would not require a conventional telephone line to either receive or place local calls since these calls could reach the second user 54 via the cable 58.

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It is to be noted that modems could be integrated with the telephone to packet adapter 10.

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It is also to be noted that the controller circuit 20 of the telephone to packet adapters 10 and 400 may generate a dial tone to locally simulate the conventional dial tone sent to the A/D D/A Full duplex interface 18. The aforementioned controller circuit 20 can also generate other types of dial tones such as, for example, audio files.

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As will be easily understood by one skilled in the art, the agent software running in the controller circuit 20 of the telephone to packet adapters 10 and 400 may advantageously include supplementary features. For example, once an Internet server is interrogated to link an IP address to a telephone number, the control circuit 20 may keep this information in a database for future references in view of decreasing the required connection delays. Similarly, speed dial numbers may be assigned to such kept IP addresses.

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Also, it is to be noted that the flow diagrams illustrated in Figures 3-5 are schematised and that actual flow diagrams would be a lot more complex and would include other rules for routing the calls. For example, if the telephone to packet adapter detects that an emergency number (911 in North America) has been dialled, it will automatically take the telephone line and dial this emergency number.

Furthermore, it is to be noted that the flow diagrams illustrated in Figures 3-5 are not mutually exclusive. Indeed, the software agent may determine how to route a call depending on the interfaces that are connected to external devices and on users preferences, for example.

Therefore, the software agent embedded in the controller circuit 20 is used to compute a route based on information acquired or stored locally as well as information acquired from a network server. A calling method is derived from these rules and is used to determine which interfaces will be involved in the process of completing the call. The appropriate route is triggered from the embedded software agent running in a central processing unit of the controller circuit 20. The embedded software agent may decide to exchange route information with an intelligence server located on the network in order to make optimal routing decisions. The embedded software agent will decide when it is appropriate to select whether to use the packet network interface or the telephone network interface to carry through a call. This method permits of using a dedicated connection to a packet network in the home as a mean for automatically diverting some telephone calls through a least cost route.

As will be easily understood by one skilled in the art the above-described invention provides many advantages, such as, for example:

- the use of an alternative packet-switched network instead of a conventional telephone line to make telephone calls;
 - it does not impose on the end user a different usage habit;
 - it is fully transparent to the end user;
 - it is possible to concurrently transmit many types of data between users. For example, two users could be in a conversation via telephone sets hooked to respective IO ports 12 and transfer data from Personal Computers connected to respective IO ports 13; and
 - it provides a PSTN fallback.
- It is also to be noted that the telephone set hooked up to the apparatus sees the apparatus as its first telephone switch, which can potentially provide more services than the PSTN telephone switch, due to its connectivity to the packet network, the services offered in the packet network and due to the level of programmability that is possible in the apparatus.

- As will be apparent to one skilled in the art, the telephone to packet adapters 10 and 400 may be designed to operate with any type of PSTN telephone line such as, for example, ISDN, HFC Cable Telephony, Wireless Local Loop, wireline, wireless digital or analogue.

Although the telephone to packet adapter 10 of Figure 1 is shown provided with only one of each interfaces 18, 23, 24 and 26, it

would be within the reach of one skilled in the art to design a telephone to packet adapter provided with more than one of these interfaces if required by a particular application.

- 5 Although the present invention has been described hereinabove by way of preferred embodiments thereof, it can be modified, without departing from the spirit and nature of the subject invention as defined in the appended claims.